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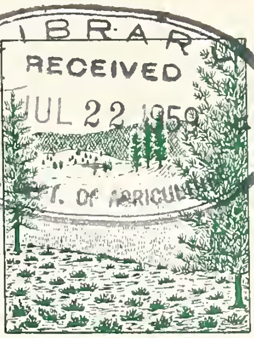

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CULL AND BREAKAGE FACTORS FOR PINES AND INCENSE-CEDAR IN THE SIERRA NEVADA

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This Research Note is an interim report of a study to determine the cull and breakage factors for all the commercial conifers in the Sierra Nevada. When the study is completed, factors for all the species will be published in the series of Forest Survey Releases reporting cull and breakage factors for forest trees in California.

The amount of cull due to defect, such as decayed wood or shake in living trees is expressed as a percentage of the gross volume of a stand to give the cull factor for that stand. When the stand is harvested there will be additional loss due to breaking of sound wood in the process of felling and bucking. This additional loss, when expressed as a percentage of the gross volume of the stand, is the breakage factor for that stand.

The cull and breakage factors presented here are of the general or "flat factor" type. They were prepared for use in the Forest Survey and were derived from averages of cull for two subregions -- the eastside and westside Sierra Nevada; therefore, they should not be expected to apply to individual trees, nor to give accurate estimates for stands of limited area. Rather, these factors should be applied to extensive stands or tree groups which are units of such stands.

Cull factors become larger with increasing age of the trees. For this reason, separate cull factors have been determined for tree classes constituting different age groups in Dunning's tree classification.[1]

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[1] Dunning, Duncan. A tree classification for the selection forests of the Sierra Nevada. Jour. Agri. Res. 36(9):755-771. May 1, 1928.

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Although more breaks occur in harvesting older trees, the percentage occurring in sound wood remains fairly constant. This is especially true in the more defective species such as incense-cedar. Because the percent of breakage for incense-cedar is so small in comparison to the cull factors, different breakage factors are not given for each of the tree classes or age groups in this species. Separate breakage factors are presented, however, for the various age groups in the less defective and more valuable pine species.

Use of Cull and Breakage Factors

To determine the net sound volume in standing trees, use only the cull factors, but to determine the net harvestable volume, use both the cull and the breakage factors.

To use these cull factors properly, the cruiser will need to tally trees by classes or age groups. The gross volume of all trees in each class or age group is then discounted by the percentage indicated as the cull factor for that group.

Breakage factors for the pines also are applied to age groups. For incense-cedar, the breakage factor is a constant for all age groups. Breakage factors are directly additive to cull factors for the determination of the total woods loss when a stand is harvested.

Some of the data upon which the breakage factors are based were collected in an earlier logging era; consequently the factors may be somewhat low when employed with the current felling methods and generally rougher logging shows.

Factors for the Commercial Pines

Cull and breakage factors for ponderosa, Jeffrey and sugar pine in the Sierra Nevada are given in table 1. Separate factors were originally computed for Jeffrey pine, but since the factors were not significantly different from those for eastside ponderosa, and since these species are not always readily separated, combination factors for Jeffrey pine and eastside ponderosa were considered more convenient. Likewise, separate factors for eastside sugar pine were originally computed, but later regarded as not significantly different from westside sugar pine factors. Over-all factors then were computed for this species throughout the Sierra Nevada. In a few localized areas on the eastside, where old sugar pines occurred on pumice soil, shake was found so prevalent that cull in class 5 trees was considerably greater than average for the species. Although most class 5 trees on such areas have already been cut, any cruiser who encounters old trees on pumice soil should make local observations to determine to what extent the average factors should be increased to allow for the excessive shake.

Table 1.--Percent cull and percent breakage in ponderosa, Jeffrey, and sugar pine in the Westside Sierra and Eastside Sierra Subregions of California -- by Dunning's tree classes.

Subregion and Species	Tree Classes	Percent of gross board-foot (Scribner Decimal C) merchantable volume	
		Cull	Breakage
Westside Sierra	1, 2, 6	0.3	1.1
Ponderosa pine	3 and 4	1.2	2.2
	5 and 5A	3.8	2.4
	7	9.1	1.4
Eastside Sierra	1, 2, 6	3.8	0.5
Ponderosa pine and	3 and 4	3.8	0.9
Jeffrey pine	5 and 5A	4.1	1.9
Westside Sierra and	1, 2, 6	1.2	0.3
Eastside Sierra	3 and 4	3.7	3.7
Sugar pine	5 and 5A	6.3	3.8
	7	6.7	0

The cull and breakage factors given in table 1 are derived from 8 separate studies in which 3,138 trees of all classes were observed. In addition a large but undetermined number of trees, mostly in classes 5 and 5A, were measured on 20 timber sale areas. No class 7 pines were encountered in the study bases in the Eastside Sierra Subregion.

Factors for Incense-cedar

Cull factors for incense-cedar are given in table 2. The great bulk of incense-cedar occurs in the westside type, but a considerable amount also occurs in an intermediate type where cull is similar to that on the westside. The cull factors presented here are for these two types. Only a relatively small amount of cedar occurs in the typical eastside forest. A cull study conducted in this type near Eagle Lake, Lassen National Forest, on an open, dry, east slope showed cull in incense-cedar to be approximately one-half that on the westside. It is, therefore, suggested that cruisers who encounter this species on extra-dry sites in the eastside subregion, apply cull factors equal to one-half those given in table 2. On other eastside sites, the entire factors are applicable.

Table 2.--Percent cull and percent breakage in incense-cedar in the Sierra Nevada[1] -- by Dunning's tree classes

Tree Class	Percent of gross board-foot (Scribner Decimal C) merchantable volume	
	Cull	Breakage
1	6.2	2.2
6	6.3	2.2
2	8.3	2.2
3	20.9	2.2
7	28.1	2.2
4	30.3	2.2
5	67.7	2.2

[1] In open stands on dry east slopes in the typical Eastside Sierra Subregion, cull factors equal to one-half the values given should be used.

The basis for these cull factors was provided by studies made at 5 locations. Two were cull studies and 3 dissection studies involving 1,536 trees of all tree classes. The supplemental study made near Eagle Lake consisted of 100 incense-cedar trees.

Breakage in incense-cedar is inconsiderable in comparison to the large amount of cull and generally differs little by tree classes. Hence it was desirable to use but one average breakage factor for all tree classes. In timber sales and cull studies at 19 different localities distributed throughout the Sierra Nevada, the average breakage factor for this species was 2.2 percent (table 2).